CHAPTER 6

Multiplexing

Review Questions

1. FDM, WDM, and TDM.
3. A guard band keeps modulated signals from overlapping and interfering with one another.
5. Voice channels (12 x 4 KHz) are multiplexed onto a higher bandwidth line to create a group (48 KHz). Up to five groups (5 x 48 KHz) can be multiplexed to create a super group (240 KHz). Ten super groups (10 x 240 KHz) are multiplexed to create a master group (2.52 MHz). Six master groups are multiplexed to create a jumbo group with 16.984 MHz.
7. In TDM digital signals from n devices are interleaved with one another forming a frame of data.
9. If there are *x* lines being multiplexed together and the duration of a data unit is *n* before multiplexing, then after multiplexing the data unit has a duration of *n/x*.
11. DS is the name of the service, which is implemented by T-lines. The capacity of the lines precisely matches the data rate of DS-services.
13. The number of slots is the same or greater than the number of input lines.
15. Inverse multiplexing splits a data stream from one high speed line onto multiple lower speed lines.

Multiple-Choice Questions

17. d
19. a
21. a
23. c
25. a

Exercises

27. $(4000 \times 5) + (200 \times 4) = 20.8$ KHz

29. 100 frames/second, each frame contains 5 characters (40 bits) and one extra frame bit, for the total of 41 bits per frame. Bit rate is 100 x 41 = 4100 bps or 4.1 Kbps

31. 125 μs

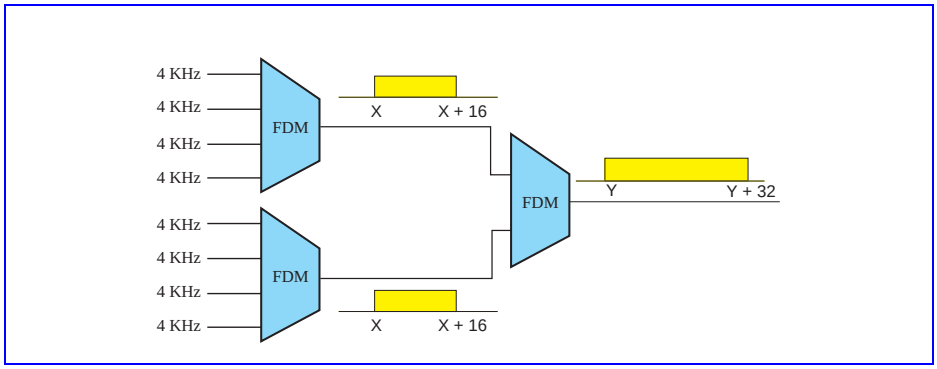
33. Nyquist theorem dictates that the sampling rate must be twice the highest frequency; 2×4000 Hz or 8000 Hz.

35.

T1 line ⇒ $(1{,}544{,}000 - 24 \times 64000) / 24 = 333$ bits /channel ⇒ 0.5%
T2 line ⇒ $(6{,}312{,}00 - 96 \times 64000) / 96 = 1750$ bits /channel ⇒ 2.7%
T3 line ⇒ $(44{,}736{,}000 - 672 \times 64000) / 672 = 2571$ bits /channel ⇒ 4.0%
T4 line ⇒ $(274{,}176{,}000 - 4032 \times 64000) / 4032 = 4000$ bits /channel ⇒ 6.2%

37. See Figure 6.1.

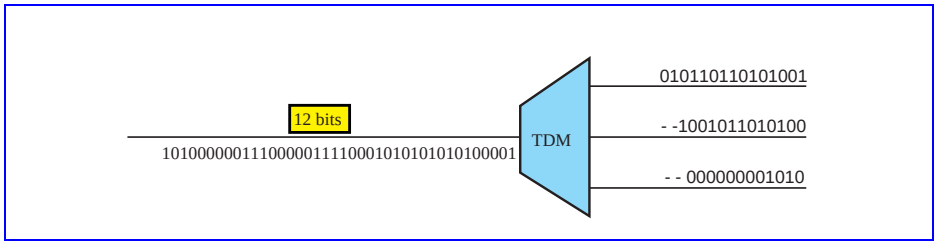
Figure 6.1 *Exercise 37*



39. 2×566 Kbps = 1.132 Mbps

41. See Figure 6.2

Figure 6.2 *Exercise 41*



43. 8 Kbps